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Argentina-Canada from 1870: Explaining the dynamics of divergence

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Abstract

Argentina and Canada started their industrialization processes while exporting natural resources and importing capital goods. These two nations were sparsely populated but received significant inflows of European immigrants since the second half of the nineteenth century. Until the start of World War II, both economies experienced similar per-capita GDPs. However, the gap between both per-capita GDPs began to grow, widening throughout the century. We carry out an empirical study of the deep determinants of the divergence process

between both economies. We confirm that while Canada was drawn into a successful path due to the adjacency with a bigger and complementary economy, Argentina fell into a “staple trap”.

Keywords: Relative per-capita GDPs, development accounting, total factor productivity,

Argentina, Canada

JEL: N12 – N16 – O11 – O57

Resumen

Argentina y Canadá comenzaron sus procesos de industrialización al tiempo que exportaban recursos naturales e importaban bienes de capital. Ambas se encontraban escasas de población y recibieron un significativo flujo de inmigrantes europeos a comienzos de la segunda mitad del siglo XIX. A comienzos de la Segunda Guerra Mundial, ambas economías poseían similares PBI per capita. Sin embargo, la brecha en el ingreso comenzó a ampliarse, profundizándose a lo largo del siglo. El trabajo ofrece un estudio empírico de los determinantes profundos del proceso de divergencia entre ambas economías, y confirma que, mientras Canadá siguió un sendero exitoso debido a la adyacencia con una economía complementaria y de mayor tamaño, Argentina entro en una *staple trap*.

Palabras claves: PIB per capita relativo, contabilidad del desarrollo, productividad total de los factores, Argentina, Canadá

Argentina-Canada from 1870: Explaining the dynamics of divergence

1. Introduction

Argentina and Canada showed until the beginning of World War II (WWII) similar per-capita GDPs. Both economies started their industrialization processes by exporting natural resources and importing capital goods. Both were sparsely populated, but received significant inflows of European immigrants at the beginning of the second half of the nineteenth century. After the

1930s, however the gap between both per-capita GDPs began to grow, accelerating later in the century. This experience was examined by a literature that, on the one hand, tries to determine the precise moment in which the divergence began. On the other hand, it tries to explain why Argentina could not break that trend and catch up with Canada.

The divergence between both countries during last century seems to be particularly relevant for Argentina for, at least, three reasons. First, at the same time that Canada reached a level of per-capita GDP corresponding to an advanced economy, Argentina lost its momentum. Understanding why this happened may help to overcome this handicap. Second, Canada has been seen as a benchmark for Argentina because of the widespread idea in the historiography that Argentina could have followed a similar path. Third, interesting questions about economic policy arise from this comparison. For example, are exogenous or endogenous the factors which lead to the dismal performance of Argentina? It would be worth to examine the differences among policies of international trade in both countries. Should Argentina redefine its development process acting directly over the apparent causes of the increasing divergence with Canada or should exploit more subtle causes of this phenomenon?

This paper has two aims. First, it shows that any explanation of the diverging path between Canada and Argentina must consider the peculiar Canadian proximity to United States. Second, the Staple theory is a useful theoretical framework to do that. While Canada was drawn into a successful path due to the adjacency with a bigger and complementary economy, Argentina fell into a “staple trap”. In evidencing our affirmations, we carry out an empirical study of the *deep determinants* (Rodrik, 2003) of the divergence process between both economies. Although similar studies have been run, our study uses a different methodology. More specifically, we run econometric tests of some old and new hypotheses, while specific points in time we used to evaluate the consistency of those results.

To do that, we first follow the works of King and Levine (1994), Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999), and offer a development accounting framework. This exercise does not directly address why output per capita differs across countries nor why the gap increased, but it provides estimates of total factor productivity, GDP shares of production factors, and an approximation of the contributions of physical and human capital, and technological progress to differences in levels of income per capita. We then use the results to explain across country income differentials in levels regressing the deficit in the Argentine performance on geography, integration and social infrastructure.

The paper contains six sections. In the second section we shall establish the absence of convergence and catching-up of Argentina. The third section presents the fundamental issues highlighted by the literature on Canadian and Argentine economic development. According to Temple (1999), historians can usefully point to particular factors that others are likely to miss. The statistical and econometric work, perhaps using cross-sections variation, is often necessary to quantify the importance of the potentially relevant factors. In this sense, the forth section introduces the methodology and the fifth presents the empirical results. Final considerations are discussed in the sixth section.

2. Argentina's *catch-up* dynamics

From the 1870s to the 1930s Argentina shows an extraordinary dynamic macroeconomic performance with an income, income per capita and GDP growth comparable to current developed countries. Between 1900 and 1930 Argentina per capita GDP did not show notable differences with per capita GDP of Austria, Germany, France and Sweden. Its performance was better than some other economies, particularly Italy and Spain. As explained by della Paolera

and Taylor “Argentina’s 1913 income level was clearly in the world top ten, and almost the top five. Whatever its exact status in 1913, for all practical purposes Argentina was an advanced country” (2003: 3). As result, Argentina received substantial foreign direct investment and massive labor immigration from Europe. Although the per-capita GDPs of US, Australia and New Zealand were always over the Canadian and Argentine ones, all these countries seemed to be in the same convergence club.

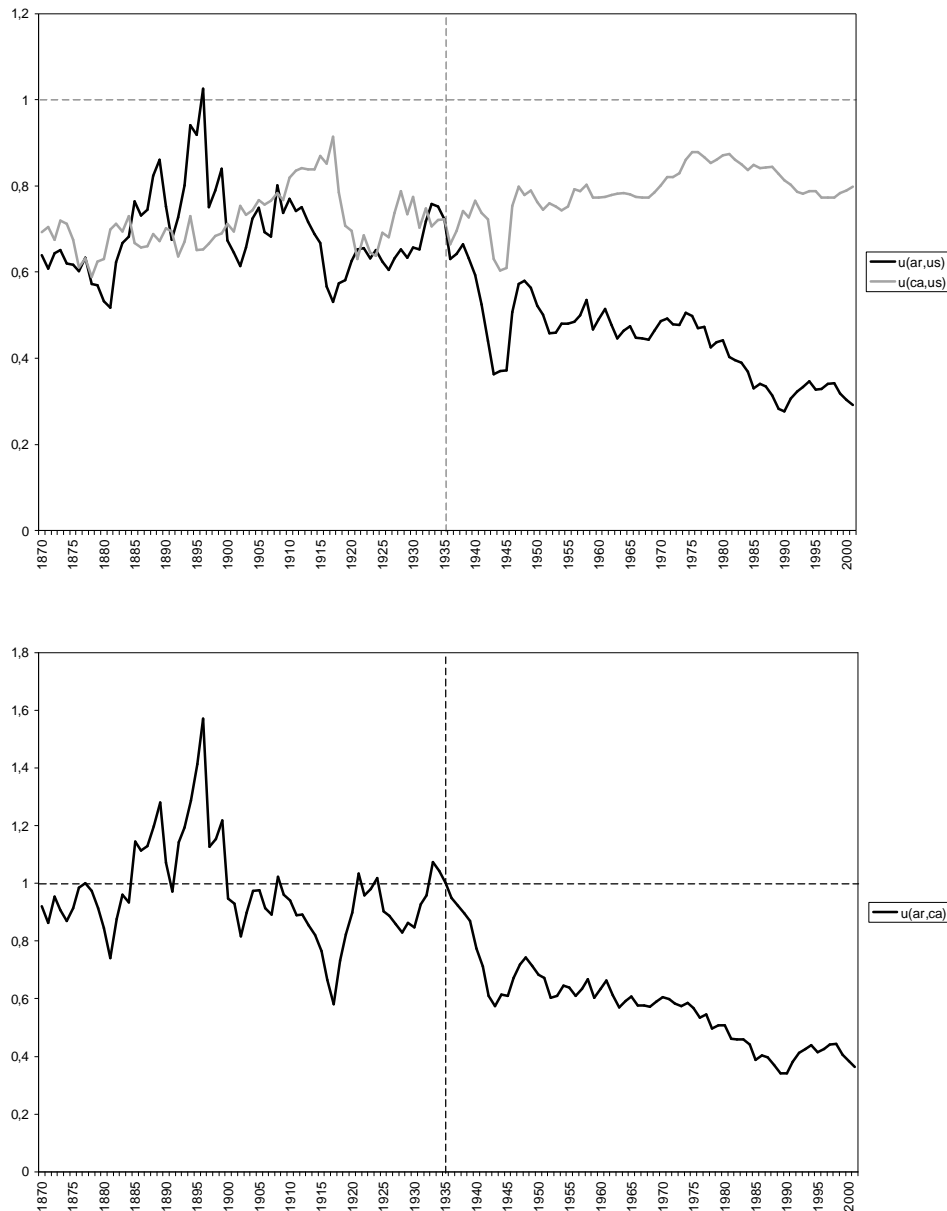
Up to the 1930s the picture changed. Moreover the data of Argentine’s economic performance since the end of the WWII shows that the country initiated a diverging path compared to the evolution of the set of economies with similar origin and others. Argentina’s ratio to OECD income fell from 80 percent in 1913 to 65 percent in 1973, and a mere 43 percent in 1987 (della Paolera and Taylor, 2003). Miguez (2005: 483) point out that between 1913 and 1989 Argentina grew to 0.74% annual while the world-wide economy did it to 2%.

In order to compare different paths of development between Canada and Argentina, we analyze data on per capita GDP of both countries relative to the US. More specifically, we study the behavior of the performance of Canada and Argentina with respect to the performance of the US over time:

$$u_{it} = \frac{\text{Per capita GDP of Country } i \text{ in year } t}{\text{US per capita GDP in year } t}$$

where the role of country i is occupied for Canada and Argentina, and the US is taken as the benchmark.

Figure 1. (a) Performance of Argentina and Canada relative to United States, and (b) Argentine performance relative to Canada



Sources: Maddison (2006) and Ferreres (2005)

Figure 1(a) plots the evolution of u_{it} for a long period of years. Several interesting facts emerge. First, the existence of at least two large dissimilar periods: one lasting from the end of XIXth century to the mid-1930s, the other starting in the mid-1930s lasting until the present day. The first is characterized by a similar path of relative performance, the other shows Canada catching-up while Argentina is falling behind US, and behind Canada. Second, Argentina and

Canada's relative per capita GDP seems to show an inverse association between the mid-1900s and mid-1930s.

Finally, Argentina's per-capita GDP steadily decreases between the end of WWII and the 1973 Oil Crisis, while Canada almost reaches its historical maximum at the end of this period. The first observation shows when Argentina lost its momentum. Argentina experienced the last peak in their per capita income relative to US before mid-1930s. The second one invites us to deepen the analysis because this period reveals the basis of the subsequent divergence behavior¹. The dismal performance between the two economies after mid-1930s became apparent in the figure 1(b) where Canada is taken as benchmark.

In the next section we discuss the historiography regarding the Argentine collapse during twentieth century. In light of this literature review we reduce the principal approaches to simple abstract relationships that we test econometrically. In this manner, we reduce the range of possible explanations.

3. Some previous studies

3.1. Studies on Canadian economic development

It is impossible to begin a survey of the studies on Canadian economic development without mentioning the staples theory of Mackintosh and Innis. Classic essays² about this approach are Buckley (1958), Aitken (1958), North (1955; 1956; 1959), Baldwin (1956), Bertram (1963), and the discussion initiated by Chambers and Gordon (1966, 1967) and followed by Dales et al. (1967), Bertram (1973), and Grant (1974) among others.

¹ This hypothesis is also presented by Korol (1991) after an interesting review of the comparative studies of Argentine decline.

² See the selections of essays edited by Watkins and Grant (2000) and Easterbrook and Watkins (2003).

“Traditionally, staple production is defined as comprising primary (resource) activities and those primary manufacturing activities, such as lumber, pulp, and paper mills and fish processing plants, in which resources are major inputs to the production process” (Hayter and Barnes, 2000: 158). The country possesses a comparative advantage in a natural resource or staple industry and this advantage is so great that this exporting sector becomes “the leading sector of the economy and sets the pace for economic growth” (Watkins, 1963: 144). Economic development is then a chain of spread effects of the export sector that transform the domestic economy and society. Watkins wrote that those spread effects are realized through three types of well-known linkages effects: backward, forward and final demand. Altman adds the fiscal linkage to the previous list. This last refers to “the income that the state receives as a result of staple and staple-related production” and “result in the investment in social overhead, such as transportation, education, research and development. Fiscal linkages can make the staple economy more efficient and competitive... On the other hand, the state can use its staple-related stream of income unproductively” (2003: 237).

Watkins also emphasizes two potential impediments to development that stem from staples production. First, “staple exporters –specifically, those exercising political control- will develop an inhibiting export mentality, resulting in an overconcentration of resources in the export sector and a reluctance to promote domestic development” (1963: 150). Second, “sustained growth requires the capacity to shift attention to new foreign or domestic markets. The former requires a favorable combination of external demand and available resources. The latter requires a population base and level of per capita income that permit taking advantage of the economies of scale in modern industrialism. Both require institutions and values consistent with transformation and that requires the good fortune of having avoided specialization in the wrong kind of staple” (p. 151). In other case, the consequence is curtailment of spread effects.

Once a region specializes in producing staples, it then finds it very difficult to reconfigure production into other types of sectors. The result is susceptibility to already volatile resource international prices, making the staples economy especially prone to crisis (Hayter and Barnes, 2000). “If the pitfalls are avoided –if staples generate strong linkage effects which are adequately exploited- then eventually the economy will grow and diversify to the point where the appellation staple economy will no longer suffice” (Watkins, 1963: 151)

Currently, there seems to be consensus about some points in time or circumstances that are empirical milestones in an economic analysis of the post-Confederation Canadian history³ the National Policy of Tariff (1879), the Import Duties Act (1919) and the Imperial Preference (1932, Ottawa Conference), and the formal alignment with US after the Reciprocal Trade Agreements Act (1934).

The National Policy of Tariff consisted in a development policy to stimulate import substitution industrialization⁴. But the intent of the government and businessmen was to protect the Canadian market and reach equilibrium in the balance of payments rather than create conditions to promote industrialization (Lucchini, 2002). di Tella (2007) said that tariffs were necessary for the railway to exist and the railway was indispensable for Canada to exist. The positive and public acceptance compelled the Liberal party to accept this policy despite a tradition of upholding the reciprocity treaties for years before.

³ The process of the Canadian independence began with the British North America Act or Constitution Act of 1867 which creates a federal system of government between Province of Canada, Nova Scotia and New Brunswick. Subsequently the Balfour Declaration (1926) established that the ex-colonies were autonomous communities united in common loyalty to the Britannic Crown and the Statute of Westminster (1931) established a status of legislative equality between the self-governing dominions of the British Empire and the UK.

⁴ The first Canadian-US reciprocity treaty was signed in 1854. There is agreement on understanding it as a defensive response against the US expansion instead of an opportunity for development. The National Policy of Tariff was the principal instrument of economic policy of the Conservative party after the federal election of 1878. The electoral success was due to the explicit opposition to the Canadian-US reciprocity treaties after the failure of the 1871 Washington Act.

Lucchini (2006) argued that the Canadian industrial sector was constituted by poor-integrated activities, and it was conducted by local businessmen with scarce foreign capital until 1870. The positive impact of the new economic program took place through a significant technological renewal. The technological progress is explained by the exploitation of scale economies, the early expansion of hydroelectricity, and the increasing share of US capital on domestic firms that took advantage of protected market. The industry concentrated over a smaller number of firms controlled by foreign capital. Although this early industrial development, the agricultural sector maintained their leading role. The period between 1901 and 1911 has been characterized by a boom in Canadian wheat exports and considered by many scholars as having been critical to Canada's economic development (Altman, 2003).

The Import Duties Act (1919) and the Imperial Preference (1932) lowered duties to the production with Imperial origin, and products that came from the Commonwealth, respectively. The industrial businessmen united in the Canadian Manufacturers' Association –to a large extent, these men were executives of subsidiary of US firms- proposed an Imperial import substitution policy similar to the Canadian one. The preferential treatment was given by the Britannic Crown to a substantial number of Canadian manufactures from 1919. During the years of the Great Depression, UK hardened its stance as response to the trade police of US and Continental Europe, and Canada was obliged to make an effort to keep the British market. As result, the Imperial Preference was agreed upon at the 1932 Ottawa Conference, and Canada government saw it as “a means of putting pressure on the US to reverse its 1930 tariff increases” (Pomfret, 2000: 118). However, one of the indirect effects of this policy was the growth of the US investment in Canada with positive and transcendent implications on Canadian exports of manufactures.

Canada takes away from confrontation with US by the enactment of the Reciprocal Trade Agreements Act (1934). Later, Canada signs a new bilateral agreement in 1935, an agreement with US and UK in 1938. After 1947, Canada embraced multilateralism following those countries, principally US (Pomfret, 2000)⁵

3.2. Studies on Argentine economic development

Asencio (1995: 13) assumed that disentangling the Argentine enigma is not lamentably an original determination. Not only taken Argentina alone, but through the comparison with Canada, Australia⁶, United States⁷ and other countries with, at least notionally, similar initial characteristics. In the first case, Ferrer (1963), Díaz Alejandro (1970), di Tella and Zymelman (1967, 1973), Cortés Conde (1997; 1998), Vázquez-Presedo (1992) are classic references between historians and economists. More recent efforts are della Paolera and Taylor (2003) and Rapoport (2005).

Between the Argentinists exists a certain agreement on describing the Argentine economic structure between 1880 and 1930 as an agro-exporting peripheral countries. Similar to Canada, the economic growth was closely related with the primary sector and the government and foreign investment in basic infrastructure. Moreover, the shortage of labor force made possible the coexistence of the enriched elite not necessarily associated with the production and export of primary goods, and the work class with a relatively high income compared with the income in the European economies. This last characteristic together with the perspectives of prosperity, promoted an important wave of immigrants and a substantial flow of foreign investment attracted by the domestic market in expansion. During that period, the trade policy was

⁵ Finally, Canada liberalized trade substantially with the implementation of Canada-US Free Trade Agreement in 1989 and subsequently with the North American Free Trade Agreement (NAFTA).

⁶ See, for instance, Fogarty et al. (1979) and Duncan and Fogarty (1984, especially their annotated bibliography from page 177 to 199). More recently Gerchunoff and Fajgelbaum (2006) and the set of papers presented in the 2007 Seminary John Fogarty at CEI (Argentina).

⁷ See, for example, Véganzonès and Winograd (1998).

essentially free-trade except for some protected sectors (Lucchini, 2002). The Argentine history did not begin in 1880; however it is a widespread opinion among Argentinists that was that year when there were consolidated the central government and the institutions needed for an economic program based in agro-exporting sector.

In analyzing Argentine development, Geller (1975), Cincunegui (1982) and Fogarty (1985) applied the staple theory. Accordingly to those authors, the model could be used to explain the early stages of development when the primary sector had such influence –direct and indirect– over the economy. Afterwards, other sectors replaced it and the model loses its explanatory power. Fogarty concludes that explanations about poor Argentine development are to be found in supply-side factors such as “entrepreneurship and capacity for innovation or in non-economic factors like the institutional environment and government policies” (Korol, 1991).

There is a vast discussion about what are the processes that explain the delay of Argentina taken into consideration the period of similarity with Canada. Many studies use the comparative method to analyze the Argentine performance. The Canada-Argentina comparison has been particularly fruitful⁸. Generally, the analyses converge on the reaction of the government and other economic agents to the “historical accidents of relevance”⁹. They point out political, institutional and even geographical and sociological constraints to the process of decision making.

⁸ Usual references are the collections of papers edited by Platt and G. di Tella (1985, 1986), Taylor (1994), Solberg (1987), Adelman (1992, 1992b, 1994), Teichman (1982), Sabato (1988), Waisman (1987). More close in time, Asencio (1995), Chudnovsky et al. (2000), Muchnik (2003), Miguez (2005), Sanz Villarroya (2005), T. Di Tella (2007), and Prados de la Escosura y Sanz Villarroya (2008).

⁹ The expression corresponds to Gerchunoff and Fajgelbaum (2006: 55).

Gerchunoff and Fajgelbaum argued that after the crisis of WWI “in the middle of the uncertainty, each country¹⁰... sought refuge in its recent history to define future policies. Argentine policymakers had no reason to deny what had produced huge returns, and, as a consequence, the deep political changes that followed the electoral reform of 1912 were accompanied by barely superficial changes in economy... it became evident that the bet on trade stayed firm, and even the inherited protectionism was losing strength something opposite to what was happening in other latitudes” (2005: 16-17).

After 1929 “there was not much to argue in a world devastated from the commercial and financial viewpoint,... it was necessary to promote manufacturing, to stimulate the expansion of the domestic market and to obtain as much profit as was possible... from the battered export activities” (p. 18-19). These authors argued that the explanation about the different paths until WWII could be explained by a time lag. Nevertheless, WWII meant not only a new closure of trade that encouraged import substitution, but an important possibility for allying oneself with a new world-wide economic power. In contrast, Argentina bet on the external conditions would be the appropriate for the balance of payments and kept the commercial alliance with UK while flirted with Axis powers. The terms of trade fell after the war and “the fifties were dominated by the stop-and-go, and when exports started resurging, Argentina had become the arena of a distributive struggle” (p. 26). At this point, the geopolitical aspects play an important role in this story of divergence. Could this analysis made for the comparative development analysis between Argentina and Australia, be useful for our purposes?

The Canada-Argentina historiography seems to answer affirmatively. Rapoport (1994) argued that until the XXth century, Argentina’s system of land distribution stamped a particular production character –principally stockbreeding- and decided the most influential interest

¹⁰ Argentina and Australia in this case, but this aspect is similar to Canada as we will see below.

group¹¹. The preponderance of the landowner over the remaining political groups would explain, according to Rapoport, the strong Anglo-argentine connexion around the middle of XXth century with lasting effects over the economy, specifically, the excessive relevance of beef and the delay in the productive diversification.

Rapoport mentioned that after the WWI, US investment growth principally in those sectors with cost advantages and access to the British market¹². Despite the trade between Argentina and US grew notably during the war, after the peace the US imports with Argentine origin returned to pre-war level while its exports kept high. The imbalance with US and the stagnation of the exports towards Europe led Argentine economy to experience difficulty with balance of payments after the 1930s. Hence, the Imperial preferences became a hazard for the sectors related with the primary exporters: In that moment 33% of the production was exported toward UK. Argentina made an effort to keep the market but results were mediocre. In 1933 both countries signed the Roca-Runciman Agreement; the pact was only useful for reducing the backward movement of this market but not to alter its existence (Asencio, 1995) meanwhile Argentina gradually moved away from US economy¹³. The Great Depression led Argentina to seek refuge in the domestic market; however it did not get the expected results¹⁴.

¹¹ Asencio (1995) argued that the agrarian revolution was not possible until the massive immigration because cultural, technological and economic factors and the combination promoted a process of collateral expansion of the agriculture dependent on the stockbreeding expansion. Between the factors of delay the author mentions the generalized view of the farming activities as non-noble, the limited propensity for scientific advances and the lack of means of transport and storage. But the massive immigration also had a delay due to some factors, one of them the access to land. Neither the early Rivadavia's attempt (1922) nor the Liberal policies of Mitre, Sarmiento and the Avellaneda Law (1876) had the effects of the Canadian Homestead Act (1872). Between 1833 and 1853, and even some years after of the Roca's Big Campaign of Desert (1879), the distribution of land followed a prize-giving pattern with a tendency to the concentration of land into large establishments.

¹² Towards the 1920s, US capital took control of the meat processing industry (Smith, 1983).

¹³ The temporary improvement during the beginning of WWII was lost because the Argentine neutrality.

¹⁴ In terms of Ferrer (1963) there was an error of design of economic policy; it had as consequence a "non-integrated" industrialization and a great dependence of imports of capital and intermediate goods. Similarly, di Tella and Zymelman (1967) argued that "structural imbalance" had been obvious, largely due to the "great delay" occurred between the WWI and the Great Crisis.

In contrast, despite the institutional links with UK, at the beginning of the XXth century Canada was an economy with a diversified production and less dependence on primary exports. Moreover, the division of land into smallholdings and the early industrialization process made that the more powerful interest group was the manufacturer one (Lucchini, 2006) and its principal objective to hold the economic links with US without losing the advantage of being a member of the Commonwealth¹⁵. Despite the toughening of the US policy and the Ottawa response reduce outstandingly the trade between both countries, the treaty of reciprocal preferences enacted in 1935 returned to the beginning the commercial plane while the alignment with US to the WWII reinforced the political relationship so that economic links were strong like never before.

4. Methodology

4.1. Development accounting

In Caselli (2005: 681) we find a synopsis of what we know as *development accounting*: it “uses cross-country data on output and inputs, at one point in time, to assess the relative contribution of differences in factor quantities, and differences in the efficiency with which those factors are used, to these vast differences in per-worker incomes”. Similarly, King and Levine (1994) present Denison’s definition in such terms: “While a development accounting question is what part of cross-country differences in income per capita is accounted for by differences in physical capital per capita, a growth accounting question is what part of cross-country differences in growth rates of output is accounted for by differences in growth rates of capital per capita”. We consider, agreeing with Hall and Jones (1997), that growth research has not

¹⁵ Promfret (2000) mentioned that “At Confederation in 1867 Britain supplied 60 per cent and the USA 32 per cent of Canada’s imports, but by 1938, despite Imperial Preference, the shares were 18 per cent from Britain and 63 per cent from the USA. The reorientation was reinforced during the 1920s by a sharp change in the source of capital inflows. In 1920, 53 per cent of the foreign capital in Canada was British and 44 per cent from the USA, but by 1926 these proportions had been reversed and in 1930, 36 per cent was from Britain and 60 per cent from the USA” (p. 116/117)

provided effective explanations for the extreme diversity in output per worker across countries, and a study of levels in economic activity could give complementary insights.

Country performance is driven by other fundamental determinants not directly captured in typical accounting (factor accumulation and technological efficiency). Hall and Jones highlighted the *social infrastructure*, defined as the collection of laws, institutions, and government policies that make up the economic environment, and they considered that “a perverse infrastructure discourages production in ways that are detrimental to economic performance” (op. cit.: 174). Their works conclude that when social infrastructure favors *diversion* of resources over *production*, investment in physical capital, skills, and the transfer of research and technology are reduced. Hence, social infrastructure affects income levels per worker through each element of the production function.

The concept of social infrastructure is associated with the notion of *cultural differences*, presented by Acemoglu (2007). He argues that cultural differences determine individual values, preferences and beliefs. We could expect that these cultural differences then led to dissimilar institutional arrangement.

Other sources of direct differences, according to Rodrik (2003), are *geography* (climate and resources) and *integration* to the world economy. Using an expression of Acemoglu, “geographic differences that affect the environment in which individuals live and that influence the productivity of agriculture, the availability of natural resources, certain constraints on individual behavior, or even individual attitudes” (2007: 23). Rodrik argued that geography also affects income via integration –for example, access to the market and transport costs- and institutions -e.g. geopolitical considerations and effects of natural resources-booms in quality of institutions-.

All of them argued that this deep or fundamental determinants change slowly or hardly at all in time. As they, we are interested in the long-run determinants of economic success and not in the transition dynamics; hence we put special attention to historical episodes that represent an institutional break or abrupt changes in rules-of-game. In this sense, Rodrik argued that “moderate changes in country-specific circumstances, often interacting with the external environment, can produce discontinuous changes in economic performances”.

Our departure point is the development accounting exercises performed by Mankiw, Romer and Weil (1992), Klenow and Rodriguez-Claire (1997) and Hall and Jones (1999). Accordingly, consider the following aggregate production function with constant returns,

$$Y = K^a H^b (AL)^{1-a-b}$$

where Y represents output, K the (total) stock of physical capital, A is a productivity index, and L is the number of (employed) workers in the economy. The total stock of human capital is the product of the average level of human capital, h , and the number of workers ($H = h \times L$). This production function can be rearranged as

$$\frac{Y}{L} = \left(\frac{K}{Y} \right)^{\frac{a}{1-a-b}} \left(\frac{H}{Y} \right)^{\frac{b}{1-a-b}} A$$

In order to consider per capita income instead of per worker income, let P be total population.

Using the relationship¹⁶

$$\frac{Y}{P} = \frac{L}{P} \times \frac{Y}{L},$$

we rewrite the production function as

¹⁶ Blyde and Fernández-Arias (2005) and Manuelli (2005) used similar expression while Hopenhayn and Neumeyer (2004) used income per worker to explain the Latin American performance relative to developed countries.

$$(1) \quad y = l \left(\frac{K}{Y} \right)^{\frac{a}{1-a-b}} \left(\frac{H}{Y} \right)^{\frac{b}{1-a-b}} A$$

where $y (\equiv Y/P)$ is per capita income and $l (\equiv L/P)$ is the employment rate; $\frac{K}{Y} (\equiv K/Y)$ and $\frac{H}{Y} (\equiv H/Y)$ express physical and human capital intensities¹⁷. The effect combined of the three components can be interpreted as the effect of factor accumulation. We follow King and Levine (1994) and use the Perpetual Inventory Method with steady-state estimates of initial capital in the construction of K series¹⁸. Similarly, we follow Mankiw et al. (1992) to compute the human capital intensity

$$\frac{H}{Y} = \frac{I_H/Y}{n + g_{st} + \delta}$$

where I_H is the inversion in human capital, g_{st} is the steady-state growth rate of the country, n is the growth rate of the country's population, and δ is the rate at which human capital depreciate¹⁹. I_H/Y is computed using

$$\frac{I_H}{Y} = \text{secondary school enrolment rate} \times \left[\frac{15-19 \text{ population}}{15-64 \text{ population}} \right]$$

which approximates the percentage of the working-age population that is in secondary school.

The last component in (1), the productivity index or total factor productivity, partially reflects the level of technology. However, this variable also could capture unemployment of available resources and technological inefficiency. Whereas resource unemployment could be considered

¹⁷ We use the decomposition in terms of capital intensity rather than the capital per worker ratio due to the reasons mentioned in Hall and Jones (1999). Mainly, we could distinguish between an increase in output that is fundamentally due to the increase in productivity and the increase in output that is due to factor accumulation. Authors that use the same decomposition approach are Mankiw, Romer and Weil (1992), Klenow and Rodriguez (1997) and Hopenhayn and Neumeyer (2004).

¹⁸ For initial GDP we took the average of the period 1910-13 while for the inversion rate in the steady state we took the average for the period 1915-84.

¹⁹ The same values of g_{st} , n and δ are used for both K and H estimations. The rate g_{st} is computed following Easterly et al. (1993) and King and Levine (1994): $g_{st} = I g + (1-I) g_w$; where g is the average of the annual GDP growth rate for the country, g_w is the world-wide average growth rate and $\lambda = 0.25$. Parameter n is the average of the annual growth rate of the domestic population. The period taken for the computation of the growth rates covers the years between 1910 and 1984. The capital's depreciation rate is supposed constant and equal to 0.03.

as an important measurement error in some studies, it is relatively unimportant for us. Mainly, with Blyde and Fernández-Arias, we are particularly interested in the explanation of long-run gaps between countries instead of cyclical variations in the utilization of the production factors.

Then, it is possible to undertake development accounting on the basis of the production function above. That is, we can take the ratio of two national measures of per capita income using expression (1),

$$(2) \quad \frac{y_i}{y_j} = \frac{l_i}{l_j} \left(\frac{K_i}{K_j} \right)^{\frac{a}{1-a-b}} \left(\frac{H_i}{H_j} \right)^{\frac{b}{1-a-b}} \frac{A_i}{A_j}.$$

Given data on relative quantities of factor production and specific values of α and β , we can measure cross-country differences in TFP, relationship expressed here as A_i/A_j , as residuals:

$$(3) \quad \frac{A_i}{A_j} = \frac{y_i/y_j}{\left[l_i/l_j \right] \left[K_i/K_j \right]^{\frac{a}{1-a-b}} \left[H_i/H_j \right]^{\frac{b}{1-a-b}}}.$$

To describe the extent to which labor, physical and human capital and TFP account for cross-country differences in per capita income, we begin by constructing the following ratios

$$(4) \quad j_{li} = \frac{\ln[l_i/l_j]}{\ln[y_i/y_j]} \quad j_{Ki} = \frac{\ln\left[\left(K_i/K_j\right)^{a/(1-a-b)}\right]}{\ln[y_i/y_j]}$$

$$j_{Hi} = \frac{\ln\left[\left(H_i/H_j\right)^{b/(1-a-b)}\right]}{\ln[y_i/y_j]} \quad j_{Ai} = \frac{\ln[A_i/A_j]}{\ln[y_i/y_j]}$$

The ratio j_{\bullet} expresses the fraction of differences in output per capita levels due to component \bullet .

Usually the estimates of (4) are realized for one year or one period using averages. The repetition for another year (period) or several years (periods) allows us to observe trends and guide us toward a second stage of the analysis: an explanation of the divergence path.

Thus far, we present a tool for answering which factors are more relevant to explain the divergence path between two countries (or groups of countries). But to address our central problem, that is the explanation of divergence, we must analyze what drives j_{\bullet} or, alternatively, what drives each component of the relative per-capita GDPs –expression (2)-.

In the following we shall identify the fundamental sources explaining the dynamics of divergence using the described methodology. We discriminate three wide ranges of explanatory variables: (i) Differences in the quality of social infrastructure, (ii) differences in terms of integration to the world economy and (iii) dissimilar geographic aspects.

Hall and Jones argue that social action is a prime determinant of output in almost any view and that government has at least two roles in this picture. First, the suppression of resource diversion appears to be most efficient if it is carried out collectively. Second, it has the power to make and enforce rules. Then, a government supports productive activity by deterring private resource diversion and by abstaining from diverting itself. Following the important contributions in this theme we proxy the quality of the social infrastructure by some variables:

- i. Public expenditure, defined as the average ratio of public expenditure to GDP. A higher government consumption rate is considered responsible for causing distortions to

private decisions and to compete for scarce resources (De Gregorio and Lee, 2003; Loayza, Fajnzylber and Calderón, 2005).

A significant coefficient would induce us to consider that differences in reaction to the “historical accidents of relevance” between Argentine and Canadian governments were an important aspect in the explanation. However, we also must control by differences in the performance of that governments’ reaction. Thus, we use two complementary variables: inflation and infant mortality rates.

- ii. Inflation, approximated by the natural logarithm of CPI. Macroeconomic mismanagement cause high inflation rates that affect negatively in performance by distorting relative prices and altering the fundamental terms of long-term contracts. From the Monetarist approach to the inflation, the inflation rate and public expenditure must show a positive high correlation. Alternatively, from the Structuralist point of view, growing prices would reflect production bottlenecks caused by the scarcity of foreign currency; hence the public expenditure and inflation would not be correlated but it is possible to find a significant and positive correlation between inflation and terms of trade.
- iii. Infant mortality rate. This variable could capture two different effects on social infrastructure. Abouharb and Kimball (2005) argued that researchers concerned with political and economic development across nations have examined the infant mortality rate as it relates negatively to government expenditures on health and education. This aspect is really close to the first variable mentioned, government consumption, and then we would take IMR as a complement of that.

However, Bueno de Mesquita et al. (2003) suggested that infant mortality rates are negatively related to the size of the minimum winning coalition: the smallest number of individuals whose approval is required for a leader to retain political power. These results are consistent with their claim that as the size of the minimum winning coalition increases governments need to improve the welfare of larger numbers of their citizens to retain

office. This argument is taken for us to introduce IMR as a complement the proxy variables of the quality of the polity system.

iv. Type of government regime in Argentina, captured by a dummy variable that takes the value 1 for years with any government controlled by a nonmilitary component of the nation's population and 0 otherwise. Although a civilian government is not guarantee of a democratic regime, a military government is generally associated with an authoritarian regime. Rodriguez (2005) summarized the arguments of Barro (1997) about the difficulty in identifying the effects of democracy in the performance: increases in democracy at low levels of democracy leading to high economic growth –by relaxation of restrictions on civil liberties and rights of association and property rights that are important to capital accumulation- but further increases leading to a decline in economic performance –due to emergence to redistributive pressures that reduce the stimulus for investment. But, a weak democratic or an authoritarian regime seem to be more permeable to rent-seeking groups and elites influences (Engerman and Sokoloff, 2003).

We take two complementary courses: First, we assign value 0 for the years with civilian government effectively controlled by military elite²⁰. Second, we incorporate variables that introduce a characterization of the political organization of the society through an annual score. Two variables were used in this sense: Polity and the Index of Democratization.

v. Polity scale ranges from +10 (strongly democratic) to -10 (strongly autocratic). The variable -provide by Center for Global Policy of George Mason University- is a composite index derived from the coded values of authority characteristic component variables. Marshall and Jaggers (2005) define a mature and internally coherent

²⁰ The Banks Dataset presents this variable with four possible values: (1) civilian, (2) military-civilian, (3) military and (4) other. We reduced it to a dichotomy variable taken (1) civilian and (0) other. We completed the dataset for the inter-war years and changed the values to the periods 1930-31, 1955-57 and 1976-82 originally assigned with values (2) and (3).

democracy (scored with 10) as one in which (a) political participation is fully competitive, (b) executive recruitment is elective, and (c) constraints on the chief executive are substantial.

vi. Index of Democratization. This variable -provided by Vanhanen (2002)- is the combination of two indices: Electoral participation and Electoral competition. The first one is measured as the percentage of the total population which actually voted in the same election while the second is defined as the smaller parties' share of the votes cast in parliamentary or presidential elections, or both. The two indicators are combined into an index by multiplying them and dividing the outcome by 100.

The relevance of integration to world economy has been extensively studied. It is accepted that there may not be an unambiguous link between openness and performance (Edwards, 1998; Rodriguez and Rodrik, 2000; Miller and Upadhyay, 2000; González, 2002). The literature remarks the possibility of specialization following the comparative advantages as a positive impact of openness, together with the possibility of reaching economies of scale, and the absorption of foreign technological advance and improvement in managerial practices. Moreover, trade liberalization forces to domestic firms to improve competitiveness through gains in productivity instead of diverting resources to rent-seeking and other unproductive activities.

However, Rodriguez (2005: 134) pointed out that “although trade barriers generate static efficiency losses that lower the steady state level of per capita GDP they can also raise production in industries that have positive externalities. Thus if the forces of comparative advantage lead the economy to specialize away from technologically dynamic sectors that produce knowledge spillovers then trade restrictions may, by raising output of these industries, stimulate economic growth”. Moreover, we accept the possibility that countries may differ in

their effort and ability to adopt new technologies (Eaton and Kortum, 1996; Keller, 2001). The absorptive capacity depends on the country's possibilities to redirect resources towards the process of assimilating the knowledge created by others (Kneller, 2005). Following these arguments, we attempt to capture the relevance of the differences in the process of integration to the world economy between Argentina and Canada, principally the integration with US. To do this, we take a set of variables:

- i. Openness. We approximate this variable by two usual alternatives. One of them is measured as total trade (export plus import) over GDP while the other is computed as customs duties on total budgetary revenue.
- ii. Terms of trade, taken as natural logarithm. An improvement in terms of trade relaxes the external constraint to growth and reduces the risk of balance of payment difficulties, extending the possibilities of incorporate foreign technology through imports of machinery and intermediate goods. We will intend to capture this effects using an external terms of trade index, defined as export price on import price indexes
- iii. International interest rate. Grossman and Helpmann (1991) provided the theoretical framework to explain how a developing country could achieve technology by means of foreign direct investment. Due to the effect of a particular FDI depend on its motivation we do not use a direct indicator of this variable. Instead we use the international interest rate as a measure of the opportunity cost of sinking capital. To do that we use the series of UK interest rate.
- iv. US total factor productivity index. We use Végonzonès and Winograd (1998)'s estimation of this variable as a proxy for available foreign technology.

Finally, Argentina and Canada have no relevant geographic difference. But, the distance between a country and its principal export market or the technological leader could affect negatively the performance. Kneller (2005) argues that the positive effect of frontier

technology on domestic economy could vary with physical distance if the knowledge generated in one country is not instantaneously and costless available to all. The impact of this geographic characteristic is hardly isolated; we could see its effects through the magnitude of the estimated elasticity of US TFP.

Other geographic characteristic is resource abundance, such as, arable land, mineral and water resources, and other raw materials (For example, Canadian cod and fur, and Argentine leather and beef). Following the Staple theory, we might find a strong influence of this variable on Canadian per capita GDP but also in Argentine development process. Altman argued that “whether or not the potential of a staple export is fully tapped critically depends on the available social and economic infrastructure. Therefore, two regions producing identical staples may follow quite different paths of development simply as a result of different social and economic infrastructures” (2003: 224). On this way it would be manifest a close relationship between the variables that represent the staple evolution and the social infrastructure proxies mentioned above. The question that we will try to answer is if the differences in the evolution of the staple relevance are significant when we try to explain the long-run path of the relative per capita GDP between Canada and Argentina. Hence we use:

- i. Natural resources abundances, proxied by primary production and computed as the participation of the sum of product in agriculture, fishing and trapping, and forestry on total GDP²¹. We exclude mining because we believe that the early-developed Canadian mining and the Argentine antipode could over-estimate the relative relevance of the Canadian primary sector or, in the same sense, the relative relevance of the Argentine non-primary sector. Furthermore, the reason for using the sum total of product of primary sectors is founded in the critic article of Buckley (1958: 443/4): “Although the staple

²¹ We do not include primary manufacturing that, in accordance with Bertram (1963), involves operations where relatively minor processing of domestic resources is required (p. 168).

approach assigns a strategic role to natural resources, it is not a variant of geographic determinism. Resources are a function of technology and tastes; the emergence of successive staple-producing regions is dependent upon advances in technology and changes in tastes within the larger economy of which the regions become parts". The essentially changing nature of staple exports -e.g. cod, fur, timber, wheat, oil, natural gas, iron ore, nonferrous metals for Canada according to Aitken (1958)'s sequence- make necessary to consider an aggregate measure instead of an always subjective number of individual production indexes which reduce the degrees of freedom. Nevertheless we isolate two sectors with particular implications: wheat and beef production, and introduce two complementary variables.

ii. Wheat production. This variable is a pure measure of the relevance of the wheat sector and could capture the possible impact of a different process of industrialization in concordance with the Staple theory and the relevance of the Wheat Boom in Canada.

iii. Beef exports²². As Wheat production, this variable could capture the possible impact of a different path of industrialization as it is pointed in Rapoport (1994).

4.2. The data and estimation methodology

As described below, we estimate a dynamic model of the relative underperformance of Argentina taken Canada as benchmark. To do that, we first compute the relative underperformance, u , and then we calculate the contribution of each component of the aggregate production function to this underperformance, $j_{\cdot i}$. Later, we will try to explain the developing gap using the set of variables mentioned in the previous section. The main sample corresponds to the years 1913-1984.

²² We use beef exports instead of beef production because the unusual domestic consumption of beef in Argentina.

For the first stage –i.e. the estimation and decomposition of the developing gap– the raw data are taken from some sources. Canadian and Argentine Real GDP (million 1990 international Geary-Khamis US\$) and Population are taken from Maddison (2006). The source of Argentina’s labor data is IEERAL (1986). Canada’s employment data is taken from Denton (1983) and Statistics Canada’s CANSIM database (some tables). Human capital computation requires data on population by age groups and data on secondary school enrolment. For the Argentine case, the data are taken principally from Vázquez-Presedo (1988), Banks (2003), Ferreres (2005) and World Bank (2007). For Canada, the data are taken from the CANSIM database, Banks dataset and UNESCO estimates. Our measure of physical capital is estimated by investment data from IEERAL for Argentina and three sources for Canada, these are Jones and Obstfeld (2001), Crozier (1983) and the CANSIM database. Table 1 shows univariate statistics, including the mean, standard deviation, minimum and maximum of all variables.

TABLE 1
Descriptive Statistics, 1913-1984. Argentina and Canada

Variable	Description		Mean	Std. dev.	Min.	Max.
y	Per capita Real GDP (Y/P)	<i>Arg</i>	5201.5	1590.1	2790.1	8334.1
		<i>Can</i>	8073.2	4018.0	3357.0	16472.4
$\frac{K}{Y}$	Physical capital intensity (K/Y)	<i>Arg</i>	2.14	0.46	1.49	3.36
		<i>Can</i>	3.42	0.60	1.77	4.91
$\frac{H}{Y}$	Human capital intensity (H/Y)	<i>Arg</i>	3.79	2.64	0.60	8.57
		<i>Can</i>	7.36	5.11	1.15	16.83
l	Employment rate (L/P)	<i>Arg</i>	0.37	0.01	0.34	0.39
		<i>Can</i>	0.36	0.03	0.32	0.45
Y/L	Labor productivity	<i>Arg</i>	14.13	4.76	7.48	23.81
		<i>Can</i>	21.82	9.43	9.71	37.13

Table 2 and Table 3 show correlations between pairs of variables. In the case of Argentina, income per capita appears strongly correlated with labor productivity and human capital-product ratio. Capital-product ratio shows also high correlation with income per capita, but more detailed analysis shows that correlation is stronger, but not linear (see scatter diagrams in Appendix 1). Employment rate has negative correlation with per capita income but a detailed

look at the scatter diagram shows that negative correlation coefficient emerges from later observations (i.e. 1976 and after), when employment rate fell below 35% and product grew much faster than population. Before that period, the relationship between both variables seems to be positive.

TABLE 2
Argentina. Correlation figures

	Y	$K\%$	$H\%$	L	Y/L
Y	1.000				
$K\%$	0.835	1.000			
$H\%$	0.978	0.908	1.000		
L	-0.692	-0.773	-0.720	1.000	
Y/L	0.995	0.855	0.978	-0.755	1.000

TABLE 3
Canada. Correlation figures

	y	$K\%$	$H\%$	L	Y/L
Y	1.000				
$K\%$	0.398	1.000			
$H\%$	0.950	0.527	1.000		
L	0.685	0.182	0.606	1.000	
Y/L	0.977	0.380	0.938	0.520	1.000

In the case of Canada, capital-output ratio shows a weak correlation coefficient with product per capita. A careful look of the scatter plot shows that after the 1940s a positive and higher relation between them prevails. Before that period the relation between both series becomes to negative²³. In the case of human capital-product ratio, the correlation is high and positive but only for highest levels of per capita income; in lower per capita product values the relation becomes more instable. Something similar occurs with employment rate and per capita income; at higher levels of income, employment rate increases parallel with per capita product. The relationship becomes negative in middle range income figures and turns back to be positive (but at a lesser slope) in lower levels of per capita income. These patterns alert us about a structural break in Canadian economy near 1940s that altered economic aggregates. This

²³ This relationship could be explained by the conjunction of some effects: the last phase of strong capitalization in railways and the expansion of US investment in the Canadian manufacturer sector, the increasing population by the immigration process and the negative effect of the Great Crisis on gross domestic product.

breakpoint also matches up with the period of acceleration of the gap between Argentina and Canada.

Table 4 exhibits the sources of the explanatory variables used in the second stage –i.e. the explanation of the developing gap- and gives some descriptive statistics. We proceed to estimate a linear model for explaining the divergence path between Argentina and Canada. Instead of taking $j_{\bullet,i}$, only the numerator of its expression is considered as the dependent variable. All explanatory variables but REG, UKI and UST were expressed as country ratios.

TABLE4
Sources and descriptive statistics, 1913-1984. Argentina and Canada

Variable	Sources and description		Mean	Std. dev.	Min.	Max.
<i>Roughly indicators of social infrastructure:</i>						
Public expenditure (GOV)	Ferreres (2005) and	Arg	21.7	7.9	7.9	45.4
	McInnis (2004); Public expenditure/GDP	Can	15.1	6.6	6.8	41.6
Inflation (CPI)	Ferreres (2005) and	Arg	-23.8	4.6	-27.3	-8.5
	CANSIM; Ln(CPI 1999=100)	Can	2.7	0.6	1.8	4.2
Infant Mortality Rate (IMR)	Abouharb & Kimball (2005)	Arg	78.4	30.8	30.0	138.0
		Can	59.8	49.7	8.0	186.3
Polity (POL)	Variable "Polity 2" of	Arg	-2.8	5.8	-9.0	8.0
	Gleditsch's Polity IV Data Archive ^{††}	Can	9.9	0.3	9.0	10.0
Index of Democratization (DEM)	Vanhanen (2002)'s	Arg	7.1	8.8	0.0	29.9
	Polyarchy Dataset	Can	20.4	5.2	7.2	29.3
Political Regime (REG)	Banks dataset; Argentine Regime Dummy [†]		0.7	0.5	0	1
<i>Integration status:</i>						
Openness 1 (OPE)	IEERAL (1986) and	Arg	0.4	0.3	0.1	1.0
	McInnis (2004); X plus M/GDP	Can	0.4	0.1	0.2	0.6
Openness 2 (DUT)	Ferreres (2005), Bird (1985); Customs Duties on total Budgetary Revenue	Arg	0.3	0.2	0.0	0.6
		Can	0.2	0.2	0.0	0.6
Terms of Trade (TOT)	Ferreres (2005),	Arg	4.5	0.2	4.1	4.9
	Wilkinson (1985) and CANSIM; ln(TOT 1971=100)	Can	4.6	0.1	4.4	4.7
US TFP index (UST)	Véganzonès and Winograd (1998)		757.3	219.1	435.8	1071.2
International interest rate (IIR)	Ferreres (2005); Short-term UK interest rate		4.5	3.5	0.5	15.1
<i>Geography:</i>						
Wheat production (WHE)	Ferreres (2005) and	Arg	6434.9	2188.1	2100.0	15000.0
	CANSIM; Wheat production (000, ton)	Can	12967.2	5393.9	4389.2	26714.7
Beef exports (BEE)	Ferreres (2005), Trant (1985) and CANSIM;	Arg	554.4	156.8	230.3	981.2
	Beef exports (000, ton)	Can	28.3	24.6	0.7	104.5
Natural resources abundances (NRA)	IEERAL (1986),	Arg	0.2	0.1	0.1	0.5
	Crozier (1985) and CANSIM; Primary activities/GDP	Can	0.1	0.1	0.0	0.3

[†] See text for details. ^{††} Previous to the regression process, we added 10 units to each figure of the original dataset for avoiding negative values.

5. Empirical results

5.1. Decomposing the development gap²⁴

We calibrate the production function keeping $\alpha = 0.30$ and $\beta = 0.28$ ($1 - \alpha - \beta = 0.42$) as did it Mankiw et al (1992) and Klenow and Rodriguez-Claire (1997). Vénganzonès and Winograd (1998) used the same α for a comparative historical study between Argentina and United States. Blyde and Fernández-Arias (2005) used a capital income share of 1/3 but their sensibility analysis showed no qualitative differences in the results when they use capital share of 0.4 or 0.5. Manuelli (2005) mentioned that the analysis of the individual Latin American country studies suggest values of α ranging from 0.3 to 0.7 and cites Gollin (2002)'s advice about adjusting downward the estimate of the capital share because problems in measurement. Katz et al. (2007) compute the participation of labor in the Argentine product following Gollin's methodology and achieve the value of 0.52 for our $1 - \alpha - \beta$ parameter. However, they specify a production function without human capital, and both models do not totally comparable and this value is not directly applicable. Hence, although we recognize some possible bias coming from model specification or measurement problems, the selected parameters and the later sensibility analysis let us to think that its magnitude is low.

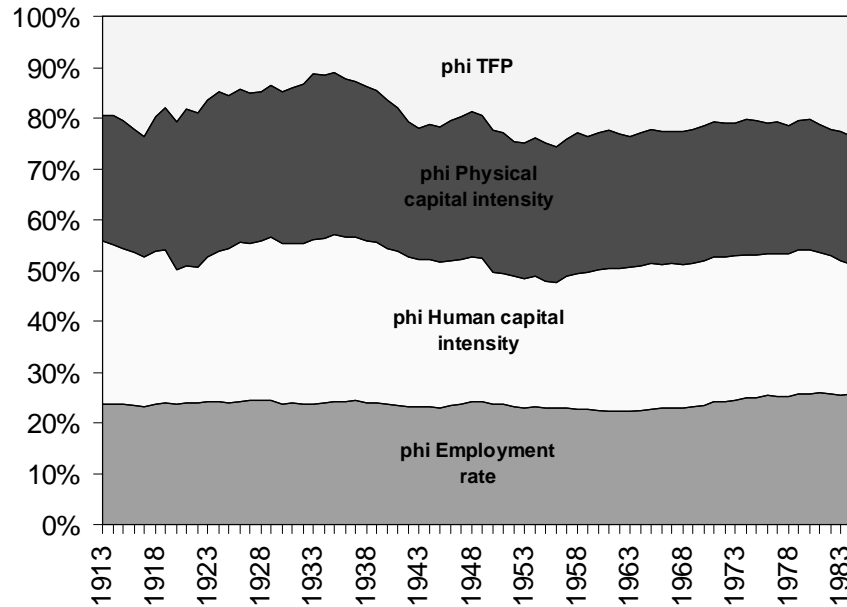
Figure 2 shows the decomposition of the relative per capita GDP between Argentina and Canada during the period, that is the evolution of index $j_{\bullet i}$ ²⁵. Roughly, factor accumulation explains 80% of per capita GDP differences between Canada and Argentina over 1913-1984. Nevertheless, technological differences are not a minor source of per capita GDP differences,

²⁴ For convenience purposes, Canadian figures are placed in numerator, thus a fall (rise) in any ratio above 1 means convergence (divergence) between both economies. While a fall (rise) in any ratio down on 1 means divergence (convergence) between both economies.

²⁵ For convenience purposes, expressions in (4) were transformed multiplying the arguments of the logarithms of the numerator by 10 and the argument of the logarithms of the denominator by 10000. Naturally all of them add up to 1 and this transformation do not change the descriptive power of the index.

accounting between 11 and 26%. The most relevant feature is that the relative importance of both aspects changed over time.

Figure 2. Decomposition of relative per capita GDP between Argentina and Canada



It is clear that there are at least four sections on the figure of the indexes. The j_{Ai} reduces its magnitude during a first phase (1913-35), then it increases substantially until 1956 (second phase) and drop again toward the same standard as the beginning of the first phase. Finally, the year 1980 starts a new phase with an increasing relevance for relative TFP. Lower values of j_{Ai} mean that TFP gap was lower than per capita GDP one. Conversely, the increases in j_{Ki} and j_{Hi} must be interpreted as signals of increasing divergence in physical and human capital-product ratios. The first and third phases matched that characterization. In contrast, during the second and fourth phases TFP, although behind factor accumulation, is gaining importance compared to fixed investment for per capita GDP gaps explanation. Table 5 demonstrates this description. Both annual dates and period averages tell a similar story: during the phase of similar per-capita income, physical and human capital intensity increased its importance and

TFP decreased its contribution to income gap. After that, when divergence between both economies tends to consolidate, TFP gap increased its weight²⁶.

TABLE 5
Decomposition of the relative per capita GDP between
Argentina and Canada

	1913	1935	1955	1979	1984	1913- 1935	1936- 1955	1956- 1979	1980- 1984
j_{li}	23.8	24.1	22.9	25.6	25.7	23.9	23.5	23.5	25.7
j_{Ki}	24.9	31.6	27.0	25.5	25.2	29.0	28.1	26.4	25.3
j_{Hi}	31.9	33.1	25.1	28.4	25.4	30.4	28.6	27.9	27.0
j_{Ai}	19.4	11.2	25.0	20.5	23.7	16.6	19.8	22.2	22.0

Periodization follows major breakdowns registered above.

Considering gaps in per capita GDP, factor accumulation and TFP evolution, our results show that Canadian take-off with respect to Argentina, started at mid-1930s. The sources of that structural change must be placed on a decline in Canadian capital-product ratio counterweighed by improvements in global efficiency. In contrast, Argentina boosted physical capital intensity at the expense of efficiency and technology upgrading. Argentina's experience illustrates that capacity expansion (not only in equipment, but also in workers' formal education) must be accompanied by growing technological competences; otherwise inefficiencies would arise and per capita income stagnates or decline over time. These results are consistent with Véganzonès and Winograd (1998). They find a relatively low efficiency of the Argentine economy after 1933 with a slower adoption of foreign technological progress and weaker diffusion.

Figure 3 shows the behavior of the Canadian, Argentine and relative TFPs for the benchmark case, forthcoming Model 1.

²⁶ Sanz Villarroya (2005) found econometrically the chronological point of break in the convergence path in 1936 and some structural breaks in the Argentine and Canadian per capita GDPs. Following her results for other periodization, we find a confirmation of the preceding analysis.

Figure 3. Canadian (thin line), Argentine (thick line) and relative (triangles) TFPs: Model 1

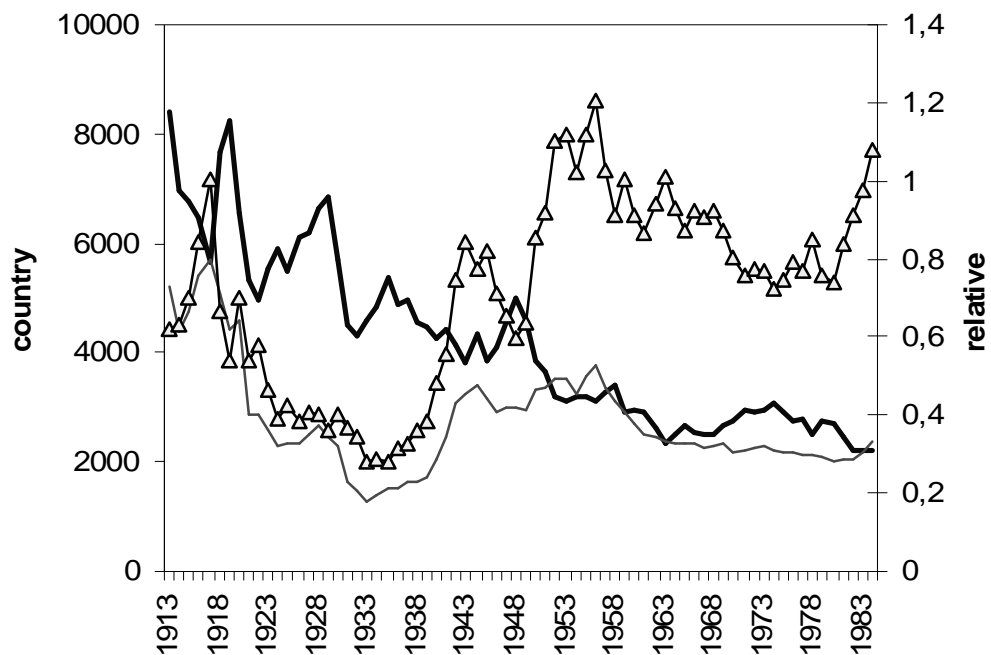


Figure 5. Canadian (thin line), Argentine (thick line) and relative (triangles) TFPs: Model 2-5

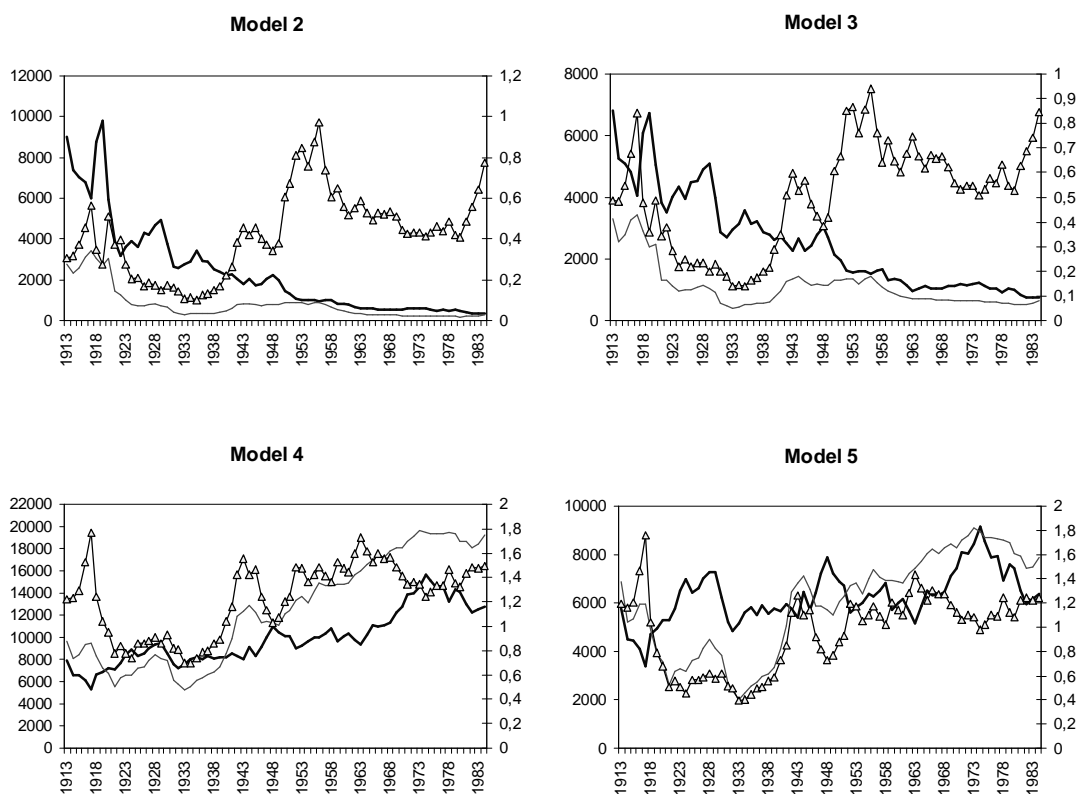


Figure 5 shows the same lines for different values of parameters of the production function. For Model 2 we use $\alpha = 0.30$ and $\beta = 0.40$ resulting $1 - \alpha - \beta = 0.30$. Model 3 is computed using $\alpha = 0.40$ and $\beta = 0.28$ and $1 - \alpha - \beta = 0.32$. Model 4 and model 5 are considered extreme because the very low participation of human capital on product. For the first one we use $\alpha = 0.30$ and $\beta = 0.10$ resulting $1 - \alpha - \beta = 0.69$ while for the last we use $\alpha = 0.50$ and $\beta = 0.01$ resulting $1 - \alpha - \beta = 0.49$.

We should note that models one to three tell a story somewhat different of the following. While they show that Argentine (and Canadian) TFP fell all over the period, it is possible draw an upward line with models four and five. But, under any estimates of A, TFP gaps between Argentina and Canada show two clear phases; the former going from 1913 up to early 1930s where efficiency gap shows a rapid increase in favor of Canada at the beginning and a downward evolution after where Argentina seems leading in technological terms. The second period, from early 1930s to 1984, covers the relative take-off of Canadian TFP. Different TFP estimations show that, besides a similar gap behavior, the levels of relative efficiency differ. When labor participation is near or above 0.5, Canada surpasses Argentina in TFP. When factors contribute in similar magnitude, Argentina is rather superior to Canada²⁷.

5.2. Explaining the development gap

As a result of the previous empirical exercise, we proceed to estimate a linear model for explaining the technological gap. The ratio between technological levels of each country, A_{CAN}/A_{ARG} , is considered as the dependent variable. Results are presented in Table 6.

²⁷ It is possible differ some sub-phases; for example, the effects on TFP of the world crises or particular aspects of the history of both countries. While the (positive or negative) effect of a specific event is the same in any case, there are differences in degrees (the magnitude of the change on the series).

TABLE 6
Explaining technological gap, 1913-1984[†]

	Model 1			Model 2			Model 3			Model 4			Model 5		
GOV	-.0282 (.6224)	-.0254 (.6591)	-.0271 (.6401)	-.0406 (.4081)	-.0358 (.4692)	-.0362 (.4671)	-.0297 (.4686)	-.0351 (.4082)	-.0386 (.3659)	.0185 (.8095)	.0173 (.8219)	.0144 (.8513)	-.0026 (.9777)	-.0058 (.9504)	-.0112 (.9040)
CPI	-1.0010 (.0811)	-1.0631 (.0740)	-1.1177 (.0647)	-1.1778 (.0214)	-1.2409 (.0195)	-1.2975 (.0164)	-.7281 (.0276)	-.7437 (.0472)	-.7661 (.0480)	-.2920 (.6715)	-.3447 (.6242)	-.3682 (.6043)	-.3520 (.6619)	-.4010 (.6226)	-.4295 (.6024)
IMR	.3403 (.0194)	.3333 (.0230)	.3223 (.0281)	.3251 (.0090)	.3223 (.0103)	.3143 (.0124)	.3811 (.0005)	.3153 (.0043)	.2977 (.0072)	.3323 (.0816)	.3174 (.0970)	.3061 (.1103)	.3907 (.0845)	.3735 (.0992)	.3544 (.1181)
POL	-.0014 (.5148)			-.0017 (.3593)			-.0016 (.3080)			-.0008 (.7738)			-.0004 (.9113)		
DEM		.0003 (.7876)			.0002 (.8295)			.0003 (.7863)		.0007 (.6649)				.0009 (.6152)	
REG			-.0196 (.5172)			-.0167 (.5124)			-.0134 (.5579)			-.0223 (.5771)			-.0322 (.4924)
OPE	-.0413 (.6060)	-.0376 (.3522)	-.0348 (.3873)	-.0546 (.1092)	-.0514 (.1340)	-.0489 (.1515)	-.0264 (.3890)	-.0241 (.4418)	-.0219 (.4813)	.0033 (.9498)	.0076 (.8856)	.0094 (.8582)	.0105 (.8658)	.0149 (.8096)	.0178 (.7735)
DUT	.0436 (.0563)	.0410 (.0702)	.0382 (.0911)	.0498 (.0116)	.0471 (.0157)	.0446 (.0215)	.0496 (.0023)	.0366 (.0318)	.0330 (.0537)	.0183 (.5243)	.0173 (.5471)	.0147 (.6105)	.0118 (.7263)	.0118 (.7250)	.0082 (.8077)
TOT	.0166 (.8394)	.0050 (.9515)	-.0023 (.9774)	.0586 (.3959)	.0469 (.4995)	.0399 (.5655)	-.0069 (.9149)	-.0133 (.8374)	-.0195 (.7631)	-.0920 (.3935)	-.1041 (.3378)	-.1079 (.3211)	-.1391 (.2728)	-.1520 (.2342)	-.1580 (.2158)
UST	.0012 (.0003)	.0011 (.0012)	.0010 (.0028)	.0009 (.0013)	.0009 (.0045)	.0008 (.0101)	.0008 (.0000)	.0007 (.0013)	.0007 (.0030)	.0014 (.0004)	.0013 (.0015)	.0013 (.0022)	.0014 (.0016)	.0013 (.0041)	.0013 (.0064)
IIR	-.0050 (.5394)	-.0038 (.6412)	-.0037 (.6467)	-.0039 (.5732)	-.0026 (.7096)	-.0024 (.7272)	-.0050 (.4019)	-.0022 (.7220)	-.0019 (.7519)	-.0056 (.6005)	-.0047 (.6566)	-.0051 (.6341)	-.0023 (.8529)	-.0017 (.8936)	-.0022 (.8612)
WHE	.0227 (.0071)	.0219 (.0090)	.0214 (.0101)	.0136 (.0499)	.0127 (.0658)	.0124 (.0734)	.0207 (.0032)	.0191 (.0042)	.0188 (.0044)	.0379 (.0009)	.0371 (.0011)	.0368 (.0011)	.0438 (.0011)	.0431 (.0012)	.0427 (.0013)
BEE	-.2812 (.2834)	-.2799 (.2853)	-.2848 (.2742)	-.2365 (.2810)	-.2343 (.2873)	-.2392 (.2745)	-.1611 (.4413)	-.1591 (.4351)	-.1632 (.4194)	-.2950 (.3956)	-.2918 (.3988)	-.2943 (.3934)	-.3480 (.3825)	-.3444 (.3954)	-.3469 (.3901)
NRA	.1645 (.1984)	.1667 (.1935)	.1668 (.1925)	.2310 (.0341)	.2361 (.0316)	.2364 (.0313)	.0817 (.3608)	.0824 (.3823)	.0814 (.3902)	-.0598 (.7203)	-.0606 (.9195)	-.0579 (.7284)	-.0912 (.6435)	-.0952 (.6286)	-.0925 (.6378)
C	-.5821 (.0457)	-.5481 (.0704)	-.4800 (.1339)	-.7311 (.0038)	-.7060 (.0073)	-.6444 (.0208)	-.7492 (.0004)	-.6031 (.0067)	-.5437 (.0199)	-.0144 (.9689)	0.385 (.9195)	.0920 (.8187)	-.3288 (.4434)	-.2684 (.5436)	-.1898 (.6834)
Observations	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71
R2	.9139	.9134	.9139	.9105	.9292	.9098	.8640	.8625	.8631	.8961	.8963	.8965	.8734	.8740	.8744
Akaike info	-2.0308	-2.0246	-2.0305	-2.3805	-2.3661	-2.3727	-2.5951	-2.5842	-2.5882	-1.4823	-1.4842	-1.4862	-1.1636	-1.1679	-1.1715
crit	.8796	1.6673	1.9844	.9322	1.9077	2.2065	4.3085	4.3578	4.4861	1.3206	2.2552	2.2377	2.6047	3.6053	3.6900
χ^2 serial corr	(.6442)	(.4344)	(.3708)	(.6274)	(.3853)	(.3318)	(.1160)	(.1132)	(.1061)	(.5167)	(.3238)	(.3267)	(.2719)	(.1649)	(.1580)
test 2 lags															

[†] All explanatory variables but REG, IIR and UST were expressed as country ratios, p-values in parenthesis. Regressions also include autoregressive term to control for autocorrelation in error terms.

Applying OLS, we first estimate a “full” model for alternative TFP ratios. For each TFP ratio regression, three alternative measures of institutional quality were included, but collinearity with other regressors hides their individual impact on efficiency gaps²⁸, although individually these indicators proved to be statistically significant (POL showed a better performance than REG and DEM). Under all estimations, only UST and WHE were found to be robust in explaining technological gaps for all values of the dependent²⁹.

At the other extreme, public expenditure (as percentage of GDP) and terms of trade variation do not exert significant influence over TFP gaps, neither in multivariate nor individual regressions under any specification of TFP. So they can be excluded from the model. The rest of the explanatory variables show a variety of results.

Inflation and duties on foreign exchange prove to be relevant under some TFP estimations but loose significance in contexts where technical efficiency participation is higher. In a sense, its robustness can be considered as weak or contingent to certain technological scenarios. In particular, DUT has a positive influence in any TFP measure. Higher values of DUT notice an economy more dependent of the international trade. So a positive coefficient points out that the greater the relative international integration the greater the magnitude of the relative coefficient of TFP³⁰.

Finally, variables like OPE, IIR, BEE, NRA show high collinearity with other regressors so their individual impact on TFP gap can not be identified. A test to check their joint contribution to TFP differences, do reject the null hypothesis about no contribution at all. So, there are signs

²⁸ Appendix 2 shows the tables with the correlation rates between pairs of variables.

²⁹ For any regression presented here, an augmented Dickey-Fuller test on residuals was carried in order to check for spurious regression. For all these trials the null hypothesis of stochastic root was rejected.

³⁰ The other variable indicating openness score has a negative coefficient in some contexts.

of their potential influence but our work can not identify their individual impact in a context of multivariate regressors.

A special commentary deserves IMR, that shows significant coefficients but the sign does not meet the expected one. A careful look at simple correlation between TFP and IMR for each country shows that during 1913-1920 Canada exhibited high infant mortality rates (that were also a major concern for population and authorities) with a major progress in TFP figures, compared to Argentinean ones. For that reason, a scatter between TFP and IMR (expressed as ratios between Canada and Argentina) shows a kind of U-shaped relationship. Actually, IMR can be considered as a proxy of inequality. In turn, higher inequality could have favored in some periods global efficiency gains (through a mechanism of worst labor conditions, lower access to social capital and consequently higher profit rates oriented to improve TFP). For some instance, this pattern supports the Kuznets hypothesis. This argument justifies the introduction of a quadratic term in regression models.

A second wave of estimations was explored introducing some adjustments to equation specification. First, as mentioned, irrelevant variables that also showed no symptoms of collinearity were omitted (namely, public expenditure and terms of trade variation). Second, it was considered a quadratic functional form between TFP and IMR. Third, POL was selected as the best indicator of institutional quality. Results are presented in Table 7.

In sum, between robust determinants of technological gaps during 1913-1984, there is one exogenous variable: geographical and political vicinity between US and Canada favors technological exchanges not emerging (at least in comparable magnitude) between US and Argentina. The other robust explanatory variable in TFP gaps is one associated with natural resource-oriented activities, giving some support to the staple production thesis. Nevertheless,

empirical results show that primary activities per se did not assure relative growth in income per capita figures. Instead, the specific orientation of these activities must be taken to enlarge technical efficiency gains. For example, meat exports and wheat production have an opposite impact on TFP gaps. In general, primary activities' weight on GDP has different impact on TFP relative gains depending upon the context. When technical efficiency contribution is higher; their impact is negative and reverts in contexts where traditional factors show upper participation figures.

TABLE 7
Results of the second wave of estimations

	Model 1	Model 2	Model 3	Model 4	Model 5
CPI	-.7528 (.1749)	-1.0890 (.0347)	-.5644 (.0566)	.0720 (.9112)	.0025 (.9971)
IMR	-.5174 (.3389)	-.1893 (.6833)	-.3101 (.3877)	-.9036 (.2027)	-1.1360 (.1611)
IMR^2	.4850 (.1045)	.2841 (.2648)	.3660 (.0390)	.7359 (.0556)	.9709 (.0237)
POL	-.0015 (.4563)	-.0014 (.4110)	-.0022 (.1124)	-.0018 (.5011)	-.0022 (.4816)
OPE	-.0429 (.2729)	-.0563 (.0919)	-.0245 (.3682)	.0058 (.9096)	.0093 (.8765)
DUT	.0499 (.0249)	.0505 (.0092)	.0643 (.0000)	.0256 (.3421)	.0284 (.3421)
UST	.0011 (.0005)	.0008 (.0038)	.0007 (.0000)	.0013 (.0004)	.0014 (.0009)
IIR	-.0074 (.3480)	-.0030 (.6507)	-.0100 (.0555)	-.0135 (.1925)	-.0143 (.2293)
WHE	.0216 (.0080)	.0135 (.0493)	.0212 (.0029)	.0354 (.0015)	.0408 (.0025)
BEE	-.2579 (.3136)	-.2316 (.2830)	-.1252 (.5473)	-.2603 (.4482)	-.3149 (.4441)
NRA	.1976 (.0981)	.2595 (.0125)	.0886 (.2707)	-.0464 (.7644)	-.0531 (.7665)
C	-.1776 (.6236)	-.4194 (.1803)	-.4064 (.1090)	.4546 (.3401)	.1440 (.7945)
Observations	71	71	71	71	71
R2	.9173	.9105	.8725	.9007	.8785
Akaike info crit	-2.0992	-2.4089	-2.6873	-1.5551	-1.2330
χ^2 serial corr test 2 lags	2.5357 (.2814)	1.4390 (.4870)	11.0749 (.0039)	3.5844 (.1666)	4.9721 (.0832)

[†] All explanatory variables but REG, IIR and UST were expressed as country ratios. p-values in parenthesis. Regressions also include an autoregressive term to control for autocorrelation in error terms.

Another two factors (though lesser robust) shape TFP gaps. One of them is associated with short-term economic polity (inflation) and the other (duties on foreign exchange operations)

depends on several internal and external factors (trade policy, but also international prices, profit rate of export and domestic market oriented sectors, firm decisions, etc.). In any case, concerning specifically duties, governments can effectively influence the direction of that indicator but its ex post magnitude depends on other factors more complex to control.

There is another group of regressors with no individual significance but involved in collinearity problems (like, infant mortality rates, measures of institutional quality, openness, and international interest rate) where our work can not be conclusive.

6. Final considerations

Comparative studies between countries allow us to identify by contrasting the parties, questions or problems which are underestimated or go unnoticed. They offer, above all, the opportunity to understand better the causes of the success or failure, the dissimilar impact of environmental or human factors, etc. (Rapaport, 1994: 175). The “Argentine failure” abounds in explanations, for that reason we have not set out to deepen something but to take which the literature remarks and to contrast these with the available statistics and a quantitative approach.

We can ascertain that the development process of Canada moved away from the Argentinean. Around the period between wars, Canada reached an advanced stage of industrialization through a process of import substitution meanwhile Argentina went through a crisis associated with the exhaustion of the agro-exporting model. After the WWII, Canada has been one of the most prosperous economies while Argentina suffered the difficulties related with the failure of the model of import substitution, the stagnation of its production, high inflation and severe redistributive problems.

Why did similar political instruments have so different results? Is it just a question of timing, design, social or political peculiarities, accident or has some exogenous actor been determinant? We showed quantitatively which elements have been more statistically significant. We concentrated in the relative TFP figure after establishing that it was the more important component explaining the relative per-capita GDP dynamic. The econometrical exercise produced the desired results.

First, we could reduce the number of hypothesis. Neither the idea of an Argentine government with excessive size nor the thesis of more severe balance of payments constraints seem to be significant to explain the behavior of the relative technological advance. In contrast, the Canadian Wheat Boom and Canadian alignment with US are the most outstanding factors. Moreover, the greater Argentine world integration in the first phase favored a better technological performance with respect to Canada, but the roles were exchanged in the second phase.

More evidence is necessary to explain the relevance of some aspects concerning social infrastructure. The relevance of the dissimilar grade of government's interferences to private decisions seems to be debatable. Inflation, taken as a result of macroeconomic mismanagement, is significant only in some calibrations. Given these scenarios, the effects on contracts and incentives of higher inflation rates in Argentina have harmed its TFP evolution. However, the results about the differences in the quality of the political system were not what we expected. High collinearity makes it impossible to conclude about the effects of political instability and repeated change to authoritarian governments in Argentina. Nevertheless, the positive and robust results for the relative IMR opened an interesting window for future research.

Second, our results offer more evidence in favor of Altman, Dales and Bertram -against the Chamber and Gordon's position- about the relevance of the Wheat Boom in the Canadian development process.

Finally, Canada was drawn into a successful path due to the proximity to the United States, a bigger and complementary economy. Geography stamps on this process a peculiar feature. Nevertheless there had been endogenous factors that made it possible; sadly we do not have convincing results about that. On the other side, Argentina fell into a "staple trap" and the timing of the changes in the economic policy was the reverse of the Canadian one. Again, "explanations about the way actually chosen by a country should be sought within its society" (Korol, 1991: 7)

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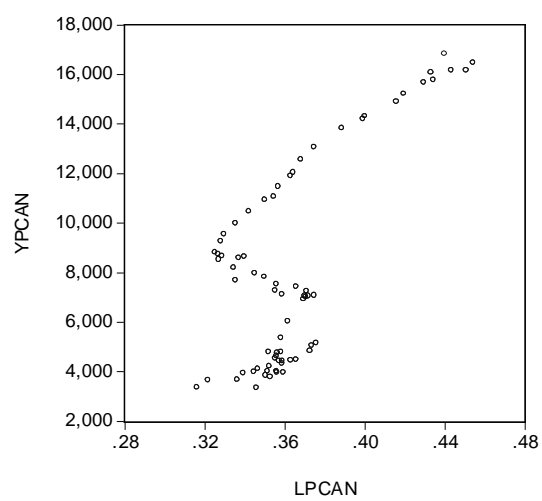
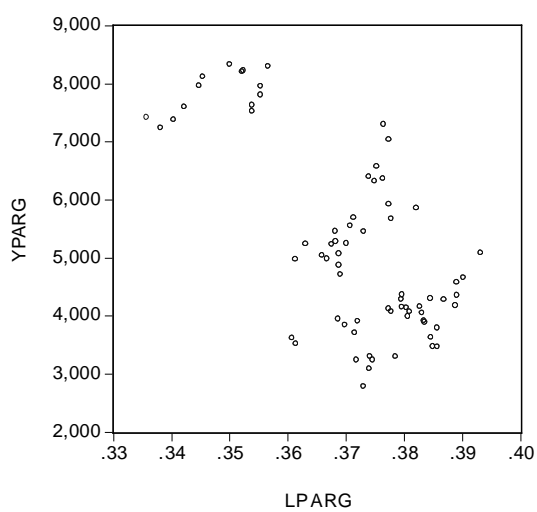
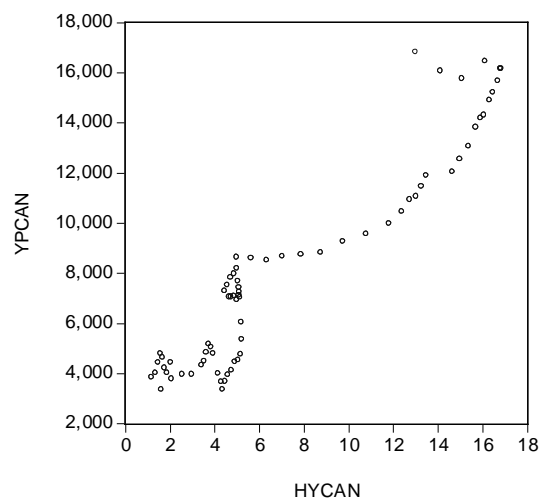
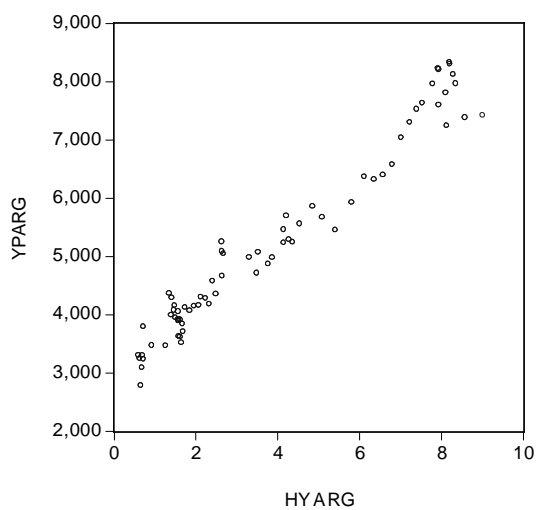
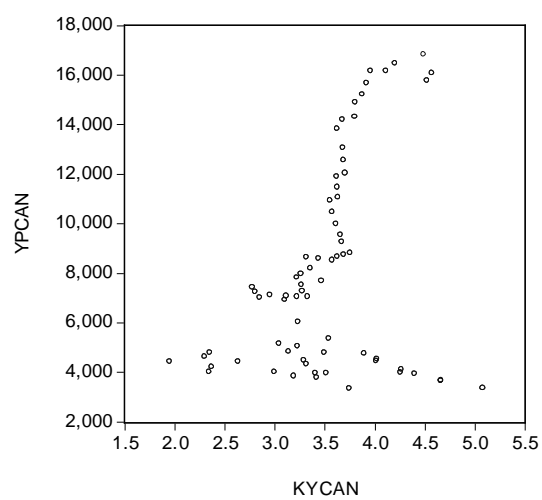
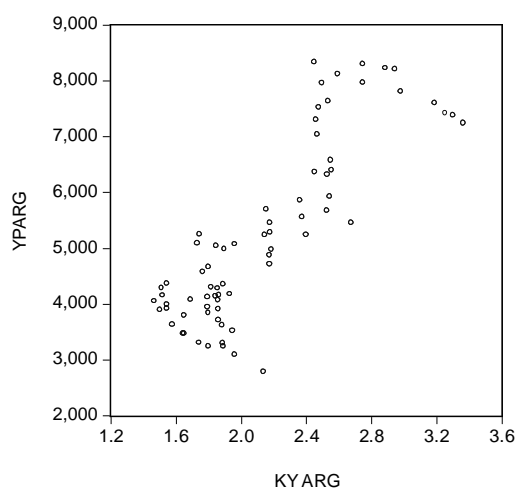
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Appendix 1 Scatter diagrams



Appendix 2 Table of correlations

TABLE A2
Canada/Argentina. Correlations, 1913-1984

	GOV	CPI	IMR	POL	DEM	REG	OPE	DUT	TOT	UST	IIR	WHE	BEE	NRA
GOV	1													
CPI	0.1390	1.0000												
IMR	0.4515	0.5887	1.0000											
POL	-0.2872	-0.1691	-0.4170	1.0000										
DEM	0.0431	-0.3225	-0.3674	0.4834	1.0000									
REG	-0.0595	0.3121	0.4117	-0.5251	-0.8996	1.0000								
OPE	-0.1751	-0.5338	-0.7449	0.5172	0.4206	-0.4657	1.0000							
DUT	-0.3011	0.1420	-0.0429	0.1399	-0.0958	0.0425	0.2895	1.0000						
TOT	0.0047	-0.0739	-0.1069	-0.0830	0.1678	-0.2050	0.0088	0.1345	1.0000					
UST	-0.2022	-0.6697	-0.8719	0.4369	0.5196	-0.5435	0.8638	0.0413	0.0653	1.0000				
IIR	-0.0573	-0.7532	-0.4376	0.0937	0.4413	-0.4199	0.4965	-0.1773	0.3302	0.6178	1.0000			
WHE	-0.1719	-0.1627	-0.2829	0.3135	0.1872	-0.1712	0.3948	0.1535	0.1092	0.3151	0.1597	1.0000		
BEE	-0.0117	-0.7265	-0.3744	0.2243	0.1330	-0.1510	0.4405	-0.0709	-0.1121	0.4964	0.3815	0.1565	1.0000	
NRA	0.2017	0.4245	0.5950	-0.0592	-0.3094	0.3513	-0.3222	0.1408	-0.1107	-0.5515	-0.3546	0.1406	-0.0483	1.0000